UKCPR
University of Kentucky
Center for
Poverty Research

Discussion Paper Series
DP 2019-05

ISSN: 1936-9379

Childhood and adolescent food security and young adult outcomes

Colleen Heflin
Maxwell School of Citizenship and International Affairs
Syracuse University

Sharon Kukla-Acevedo
Dept. of Political Science & Public Administration
Central Michigan University

May 2019

Preferred citation
Heflin, C. and Kukla-Acevedo, S. (2019, May). Childhood and adolescent food security and young adult outcomes. *University of Kentucky Center for Poverty Research Discussion Paper Series, DP2019-05*. Retrieved [Date] from http://ukcpr.org/research.

Author correspondence
Colleen Heflin, cmheflin@maxwell.syr.edu

University of Kentucky Center for Poverty Research, 550 South Limestone,
234 Gatton Building, Lexington, KY, 40506-0034
Phone: 859-257-7641. E-mail: ukcpr@uky.edu
www.ukcpr.org
EO/AA

Childhood and Adolescent Food Security and Young Adult Outcomes

Sharon Kukla-Acevedo
Central Michigan University

Colleen Heflin
Syracuse University

This project was supported with a grant from the University of Kentucky Center for Poverty Research through funding by the U.S. Department of Agriculture, Economic Research Service, Agreement Number 58-5000-3-0066. The opinions and conclusions expressed herein are solely those of the author(s) and should not be construed as representing the opinions or policies of the sponsoring agencies.

Abstract

Exposure to stressful life experiences during childhood, such as food insecurity, can have negative consequences for attainment later in life. The developmental timing of stressful events and how they influence outcomes over the life course is a critical area of research. Indeed, a more comprehensive understanding of the latter life consequences of childhood food insecurity could guide policy-makers in designing more effective social policies to reduce the severity of the poor life outcomes. This project uses data from the Panel Study of Income Dynamics to estimate the young adult impacts (as late as age 25) of food insecurity experienced in discrete childhood stages – middle childhood (ages 5-10), early adolescence (ages 11-14), and middle adolescence (ages 15-18). It aims to identify which childhood stage-specific effects of food insecurity are most important to five young adult outcomes in two main areas – risky sexual behaviors and criminal justice involvement. Results provide consistent evidence that the mean food security scores in middle childhood are associated with the criminal justice involvement outcome. The results are less consistent with the sexual risk taking outcomes. Middle childhood food insecurity is associated with the number of sexual partners in young adulthood, while early adolescent food insecurity is associated with the number of children in young adulthood. Results indicate that male respondents appear to be more sensitive to food insecurity than females.

Executive Summary

In 2017, approximately 11.8 percent of U.S. households were defined as food insecure according to the US Department of Agriculture (Coleman-Jensen, Rabbit, & Gregory 2018). In food insecure households, limited resources prevent access to adequate food for at least one individual. Previous research demonstrates that scarcity conditions, such as food insecurity, can distort immediate decision-making abilities because individuals funnel disproportionate levels of cognitive ability toward securing the scarce resource, resulting in suboptimal decision-making. Furthermore, life course transition theory suggests that the developmental timing of negative exposures likely influences later life outcomes differently. This analysis examines the timing of exposure to food insecurity at different stages of childhood– middle childhood (ages five to 10), early adolescence (ages 11 to 14), and middle adolescence (ages 15 to18) – and risky behaviors reported in young adulthood to see if there are particularly sensitive period of childhood where exposure to food insecurity has larger consequences on later life outcomes.

We instigate this research question by using data from and Panel Study of Income Dynamics (PSID) and the Transition into Adulthood (TA) supplement to estimate the childhood stage-specific effects of food insecurity on sexual risk-taking and criminal justice involvement. The PSID originally surveyed about 5,000 families in 1968 and continues to collect biennial data. The PSID began collecting child development data on 3,563 children (ages 0-10) of PSID household heads in 1997. The CDS allows researchers to study childhood development from infancy/early childhood through age 18. The TA supplement, begun in 2005, collects information from young adults who participated in the CDS, but who were not yet heads of household to be included in the PSID. This study uses income from the main file, food insecurity data from the main file and the CDS, and sexual risk taking, criminal justice involvement data from the TA supplement.

Our analysis shows that, even after controlling for permanent income and its variance, exposure to food insecurity during later childhood is associated with risky behaviors in young adulthood. The association with food insecurity seems to be larger and more consistent for criminal behavior than for sexual risk taking. The timing of exposure to food insecurity matters with exposure during the middle childhood period (ages 5-10) having the most consistent positive association with ever being arrested. The results are not as consistent with the sexual risk taking outcomes. Some specific findings are as follows:

- The average level of childhood (age 5-18) food security is positively associated with the probability of being arrested in models with our full set of controls. Additionally, average childhood food security is positively associated with the number of sexual partners and the number of children by young adulthood (up to age 25).
- The average level of food insecurity during middle childhood (age 5-10) is positively associated with the probability of being arrested in models with our full set of controls. Additionally, average food insecurity during middle childhood is positively associated with the number of sexual partners by young adulthood.
- The average level of food insecurity during early adolescence (ages 11-14) is positively associated with the probability of being arrested in models with our full

set of controls. Similarly, the average level of food security during adolescence is associated with the number of children by young adulthood.
- These results are particularly strong for male respondents.

After we include our full set of control variables, we find no association between the average level of food security during middle adolescence (age 15-18) and either criminal justice or sexual risk-taking outcomes.

The studies' limitation primarily concerns the different number of observed food security levels at different childhood stages because the PSID only collects data every two years and food security has not been available for the entire childhood period. Additionally, our methods are not causal and so interpretations should be appropriately cautious. There are many possible intervening factors between the timing of food security measurement and the young adult outcomes observed. Finally, while we have used a measure of permanent income (and it's standard deviation) in our models to allow us to identify the factors associated with food insecurity that are separate from the experiences of childhood poverty, our measure is far from perfect and there are likely still shared sources of omitted variable bias that remain.

I. Introduction

About 11.8 percent of U.S. households were food insecure in 2017, (Coleman-Jensen, Rabbit, Gregory, & Singh 2018). The 2017 household food insecurity rates are lower than those during the Great Recession of 2008 (~14 percent), but are still higher than those prior to the recession (11.1 percent in 2007) (Coleman-Jensen et al. 2017). In food insecure households, limited resources prevent access to adequate food for at least one individual.

Food insecurity and the associated stressors of securing nutritious food could negatively influence growing children's immediate and future social development. Scholarship demonstrates that scarcity conditions, such as food insecurity, can distort immediate decision-making abilities because individuals funnel disproportionate levels of cognitive ability toward securing the scarce resource, resulting in suboptimal choices (Mullainathan and Shafir 2013; Mani et al. 2013). However, research also suggests that stressful life experiences, such as food insecurity and poverty, can have lasting impacts, leading to poorer outcomes later in life (Holzer, Schanzenbach, Duncan, & Ludwig 2007). Evans, Li, & Whipple (2013) note that the developmental timing of exposures in affecting outcomes over the life course is a critical area of research. Indeed, a more comprehensive understanding of food insecurity impacts could help decision makers design more effective social policies to reduce the severity of the poor life outcomes.

Developmental psychology divides childhood into discrete stages, in which distinct and important cognitive and social developments occur. The different developments that characterize each stage suggests the possibility that stressors, such as food insecurity, could have differential long-term impacts, depending on the stage of childhood in which the individual experienced the food insecurity. Previous scholarship has focused on the consequences of food insecurity in early

childhood stressors, but few studies examine this question with respondents who are between the ages of five and 18 (for a notable exception, please see Hamersma & Kim (2015)). We use data from the Panel Study of Income Dynamics to estimate the young adult impacts (as late as age 25) of average food security experienced in discrete childhood stages – middle childhood (ages five to 10), early adolescence (ages 11 to 14), and middle adolescence (ages 15 to18). We aim to identify which childhood stage-specific effects of food insecurity are most highly correlated with six young adult outcomes in two main areas – risky sexual behaviors and criminal justice involvement.

Background

Food insecurity affects children through direct and indirect pathways. Gundersen and Ziliak (2015) note that food insecure children are more likely to report a number of negative health outcomes including from general health, such as fair or poor parent-reported global health and to specific health conditions such as childhood asthma. In addition, adults in food insecure households often have to make suboptimal food choices (Kirkpatrick and Tarasuk, 2008) that are especially problematic to young children's developing brains (Georgieff, 2007). Foods low in zinc and iron can cause deficiencies in cognitive development that directly impair academic performance. Given that "skill begets skill" in education production, where earlier capabilities affect subsequent learning (Cuhna, Heckman, Lochner, and Masterov, 2005), these early nutritional deficiencies may negatively affect academic performance throughout childhood.

However, some children who live in food insecure households are not themselves food insecure but are shielded from food insecurity either by their parents (Coleman-Jensen, McFall,

Nord, 2013), or by diverting food from older children in the household to the younger children (Coleman-Jensen, Rabbitt, Nord, & Singh, 2015). Yet, even in these situations, food insecurity can indirectly affect children. King (2018) indicates that having a food insecure parent in the household has negative effects on children's internalizing behaviors (including various aspects of emotional wellbeing) even if the child is food secure. In addition, the environmental stress associated with food insecurity may reduce parental mental wellness, which in turn affects children's wellbeing (Ackerman, Brown, & Izard, 2004; MacFadyen, MacFadyen, & Prince, 1996; Weinreb et al., 2002).

Research documents a host of adverse childhood outcomes associated with the direct and indirect effects of food insecurity, even after controlling for poverty and other problematic confounding variables, such as parental behaviors and mental health. Internalizing behaviors and externalizing behaviors (involving outwardly disruptive actions) are commonly studied childhood outcomes. These two sets of outcomes have critical implications for wellbeing over the life course. Using a longitudinal sample of respondents over twenty years, Masten et al. (2005) indicate that early childhood externalizing problems lowers educational attainment by adolescence. Lower academic achievement then increases the likelihood of internalizing problems in young adulthood. However, this is not a universally-accepted finding. For example, Duncan et al. (2007) provide evidence that these types of behaviors in early childhood are not always predictive of later academic achievement.

Internalizing problem behaviors, such as difficulty getting along with peers and exhibiting symptoms of depression/anxiety are linked with food insecurity in childhood (Alaimo, Olson, & Frongillo, 2001; Kleinman et al. 1998; Slack & Yoo, 2005; Slopen, Fitzmaurice,

Williams, & Gilman, 2010). Experiences of food insecurity during adolescence are also associated with a more severe internalizing behavior - suicidal ideation (McLaughlin et al. 2012).

Food insecurity is also associated with externalizing problem behaviors, such school suspension, substance use, and exhibiting symptoms of aggression/hyperactivity/noncompliance (Alaimo, Olson, & Frongillo, 2001; Kleinman et al. 1998; McIntyre et al. 2013; Slack & Yoo, 2005; Slopen, Fitzmaurice, Williams, & Gilman, 2010; Whitaker, Phillips, & Orzol, 2006). Slack & Yoo (2005) indicate that the timing of the food insecurity may matter. Their results show that food insecure older children (ages 6-12) exhibit more internalizing behavior problems, while food insecure younger children (ages 3-5) exhibit more internalizing and externalizing behavior problems.

Additional evidence suggests that differences exist among food secure and food insecure youth in non-cognitive skills (Jyoti, Frongillo, and Jones, 2005; Murphy et al. (1998). The outcomes included in this classification are diverse, but the literature generally concludes that food insecurity is detrimental to desirable social behaviors, such as cooperating with others (Dunifon and Kowleski-Jones (2003; Howard, 2011), developing interpersonal relations (Howard, 2011), and approaches to learning (Howard, 2011). Early development of this skill set is important because non-cognitive skills deficiencies can persist (Dodge & Pettit, 2003) and because non-cognitive skills are necessary for success in the classroom environment.

Why the Timing of Food Insecurity Might Matter

Previous research generally concludes that early childhood (up until a child is about five years of age) marks the most critical developmental period in an individual's life (Shonkoff & Phillips, 2000). The large number of cognitive and social changes a person experiences during the earliest years marks this childhood stage as a time when individuals are most responsive to their environments. Indeed, much of the food insecurity literature focuses on this period (Kleinman et al. 1998; Slack & Yoo, 2005; Slopen, Fitzmaurice, Williams, & Gilman, 2010; Whitaker, Phillips, & Orzol, 2006). However, important and distinctive cognitive and social developments continue throughout the life course. Life course perspective theory emphasizes the importance of understanding the impacts of a stressor, such as food insecurity, during other important childhood developmental periods. The theory suggests that the consequences of this stress will be different depending on when during childhood the stress is experienced.

Middle childhood spans roughly from ages five to 11. This stage is important due to several changes in cognitive and social development as children begin formal schooling and broaden their social interactions to those outside of the family. Many cultures across the world begin formal schooling at age six because this is when individuals develop the ability to reason and use logic, reflect on themselves and their peers, and to build upon previous knowledge (Eccles, 1999; Erikson, 1963). Socially, this age group experiences a broader exposure to social circles and more autonomy. Placement into age-specific classrooms leads to children frequently engaging in social comparisons, which is one of several important influences on their self-confidence. Generally, six year olds tend to have high levels of self-confidence that decline rapidly in the following years as they get feedback about their abilities from adults and peers outside of their family unit (Eccles, 1999). The rapid advancements in acquiring the ability to

reason, to compare themselves to others, and the rapid decline of self-confidence all provide a basis to believe that this period could be especially sensitive to the effects of food insecurity.

Early adolescence (ages 11 to 14) is secondary only to early childhood in terms of the sheer number of biological and psychological transformations an individual experiences (Eccles, 1999). The combination and quantity of these important changes make the pre-teen and early teen years challenging for many young people (Eccles, Midgley, & Wigfield, 1993; Simmons, 2017). Early adolescents begin the process of distancing from parents, demonstrate a strong desire for autonomy, and begin orienting themselves toward their peers. As noted in Eccles (1999, p. 37), "With rapid change comes a heightened potential for both positive and negative outcomes." Food insecurity effects could be especially harmful when experienced amid the rapid changes of early adolescence.

Middle adolescence (ages 15 to 18) is characterized by immature cognitive functioning, sensation-seeking and distancing from parents (Wigfield, Byrnes, & Eccles, 2006). In addition, older adolescents demonstrate more risk-taking behaviors and poorer judgement (DiClemente, Hansen, & Ponton, 1996; Steinberg, 2009). Adults do not play as strong a role in teenagers' decision making, so there are more opportunities for risk-taking during this stage. The distancing from parents could result in either diminished impacts from food insecurity if teenagers have learned how to secure food independently. Conversely, it could result in increased food insecurity if they have not learned to navigate their environment to secure food, or if they are disproportionately making harmful or risky life choices.

II. Data

We use the Panel Study of Income Dynamics (PSID) and the Transition into Adulthood (TA) supplement to estimate the childhood stage-specific effects of food insecurity on sexual risk-taking and criminal justice involvement. The PSID originally surveyed about 5,000 families in 1968 and continues to collect biennial data. The PSID covers a broad range of topics including labor force attachment, education, wealth, child development, and sociodemographic characteristics. The unusually long panel of the survey and its supplements make them extremely useful in examining intergenerational effects of family and social environments.

The PSID began collecting child development data on 3,563 children (ages 0-10) of PSID household heads in 1997. The CDS allows researchers to study childhood development from infancy/early childhood through age 18. The TA supplement, begun in 2005, collects information from young adults who participated in the CDS, but who were not yet heads of household to be included in the PSID. This study uses income and food insecurity data from the main file and sexual risk taking, criminal justice involvement data from the TA supplement. Since respondents had to "age in" to be included, the TA sample size varies by year (2005: n=745; 2007: n=1,115; 2009: n=1,554; 2011: n=1,907; 2013: n=1,804; 2015: n=1,887).

III. Research Methods

Food Insecurity

The CDS in 1997 and the main PSID family file in 1999 include a food security scale, which is a continuous, linear scale measuring the degree of severity of food insecurity/hunger experienced by a household. This scale construction adds affirmative responses from the 18 questions included in the Food Security Core module, and is then rescaled from zero to ten (as per the U.S. Department of Agriculture's convention). The food security scale variable reported

in the 1997 and 1999 PSID expresses the full range of severity of food insecurity/hunger as observed in U.S. households. In 2001 and 2003, the main PSID family file reported the eighteen component variables necessary for researchers to create the scale variables.

The analysis uses two strategies to estimate food insecurity effects[1]. First, based on the four food security data points collected in 1997, 1999, 2001, and 2003, we created a mean childhood food security variable from the observations between a respondent's year of birth and 18th year. The oldest respondents in the CDS (ages nine and ten in 1997) may have food security scale data for all four of these points, but the youngest CDS respondents will have fewer. This is discussed in greater detail below. Next, we create childhood stage-specific mean food security variables. The middle childhood average food security scale is the mean food security variable calculated from the average food security scale point estimates from ages five to 10; early adolescence is similarly calculated from ages 11 to 14; and middle adolescence is calculated from ages 15 to 18.

Table 1 presents the descriptive statistics for the overall sample and for those respondents that ever had an affirmative food insecurity response in any of the interviews. For the overall sample, the lifetime mean food security scale (FSS) is 0.89. This is fairly consistent across the three discrete childhood stages, despite the fact that we have defined middle childhood to be longer than the other developmental stages. It is noteworthy that the early adolescence period has the highest FSS (0.97) and the oldest period, middle adolescence has the lowest FSS (0.79). The mean FSSs are higher, when conditional on any affirmative food insecurity response – lifetime mean FSS is 1.39, ranging from 0.95 in middle adolescence to 1.34 in early adolescence.

[1] Lopoo and London (2016) inspire this approach.

Unfortunately, the data collection timing yielded many missing observations for some of the stage-specific food insecurity variables and only one data point for other stage-specific food security variables. As mentioned, in 1997, the first wave of the Child Development Supplement (which includes the first food security measure) gathered information from children who were ages 0-10. A child who was six in 1997 would be roughly eight in 1999; 10 in 2001; and 13 in 2003. That would mean stage specific measures would be calculated on three data points for middle childhood (ages five to 10), but only one data point for early adolescence (ages 11 to 14) and would be missing for middle adolescence (ages 15 to 18). Table 2 summarizes the data collection timing challenge. We limit our sample to ages five and up (and therefore do not estimate food insecurity effects on early childhood) because the data collection would not yield adequate data points for either the food insecurity variables or the young adult outcomes[2].

Outcome Measures

This study includes five outcome measures from the Transition into Adulthood Supplement. Four of the outcome variables are related to sexual risk taking – a binary measure indicating whether the young adult respondent had unprotected sex in the previous four weeks, the number of sexual partners at the time of the interview, a dichotomous variable equal to one if the respondent had a child out of wedlock, and the number of children the respondent is parenting at the time of interview. As shown in Table 1, 6.39 percent of respondents in the full sample had unprotected sex in the preceding four weeks, they had, on average, between five and

[2] We control for missing FSS in two ways. First, and the method shown in this paper, we created a binary variable equal to one in if the relevant FSS was missing for that time period. Second, we created two sets of binary variables – the first equal to one if the FSS was missing due to non-response and the second equal to one if the FSS was missing due to unobserved/timing issues. The results did not differ between the two estimation methods, so only the first method is presented here.

six sexual partners, and the average number of children is 0.38. In addition, roughly 18 percent of the sample had a child out of wedlock. Respondents who ever experienced food insecurity averaged slightly higher sexual risk-taking responses, with 7.39 percent reporting unprotected sex, 6.2 sexual partners, 21 percent had a child out of wedlock, and an average of 0.45 children. These differences are all statistically different (and less desirable) than in the full sample.

The fifth outcome also comes from the Transition into Adulthood survey and measures respondents' involvement with the criminal justice system[3]. This variable is an indicator equal to one if the respondent was ever arrested. The summary statistics in Table 1 indicate that 20 percent of the full sample had ever been arrested, while 22 percent had ever been arrested, conditional on experiencing any food insecurity. Again, this is a statistically significant difference.

Control Variables

We address potential endogeneity between food insecurity and income by controlling for permanent family income and the standard deviation of annual family income in the analyses presented here. The PSID measure includes the taxable income and cash transfers of all adults in the household. We take advantage of the PSID's long panel to create a mean annual family income variable. By merging the PSID, CDS, and TA, we are able to construct a full 18-year average family income (pre-tax) for each respondent. We similarly created a standard deviation of annual family income variable to measure the variance over the child's life. Prior to variable

[3] The TA includes other outcome variables that capture criminal justice involvement, such as whether the respondent served jail time in the previous six months and whether the respondent had been/currently on probation. We chose to focus on the arrest outcome in this paper because a factor analysis showed that the three criminal justice involvement variables loaded on a single factor. Additional analyses, available from the authors upon request, indicate very similar results for the three criminal justice outcomes.

creation, we use the U.S. consumer price index to inflate all annual incomes to 2013 levels. We also include concurrent maternal education level, and respondent age, sex, and race/ethnicity. In 1997 and 2002, the primary caregivers (the parents of our sample respondents) were asked to rate their neighborhood as a place to raise children. The response stem ranges from one (excellent) to five (poor). This variable is included to control for children's safety/security outside the home and spatial access to quality food sources. Table 1 reports mean values and standard deviations for each of these variables for the two samples of interest.

Estimation Procedures

We assess the relationship between food security levels during three discrete childhood stages – middle childhood (ages five to 10), early adolescence (ages 11 to 14), and middle adolescence (ages 15 to18) – on risky sexual behaviors and criminal justice involvement using a series of probit and negative binomial regressions. We estimate models with the three binary outcomes (e.g. unprotected sex in previous four weeks, child out of wedlock, ever arrested) using probit regression and report marginal effects at the mean values of the control variables to facilitate interpretation. We use negative binomial regression to estimate models with the two count variables as outcomes (e.g. number of sexual partners and number of children) and report incidence rate ratios (IRRs) for ease of interpretation.

$$(1)\ Y_i = \alpha + \beta LFSS_i + \eta X_i + \varepsilon_i$$

$$(2)\ Y_i = \alpha + \beta_1 MCFSS_i + \beta_2 MCFSS_i + \beta_3 MCFSS_i + \eta X_i + \varepsilon_i$$

All models specify the outcome of interest for individual, Y_i, at ages 18-25, as a function of either (1) the lifetime mean FSS ($LFSS_i$) or (2) the stage-specific FSS scores (middle

childhood food security scale, $MCFSS_i$; early adolescent food security scale, $EAFSS_i$; middle adolescent food security scale, $MAFSS_i$, and other covariates.

We begin by estimating the basic correlation between all FSS's and each outcome. Next, we add controls for lifetime family income and the standard deviation of lifetime income. Finally, in addition to income, we add controls for known correlates of food insecurity and risky behaviors - sex, race, maternal education, and neighborhood quality.

IV. Results

In Tables 3-6, we present results from several models reporting the relationship between the FSS and sexual risk taking outcomes (whether had unprotected sex in the previous four weeks, number of sexual partners, whether has/had child out of wedlock, and number of children). The first column in the table identifies the included controls (no controls, income controls, full control set), the second column identifies which the food security specification (LFSS or MCFSS, EAFSS, and MAFSS), and columns three through five identify the sample on which the models were estimated – full, female only, and male only. As mentioned previously, we report IRRs for the models estimating FSS on sexual partners and number of children, and we report marginal effects calculated at the mean of the control variables for the models estimating FSS on whether the individual had unprotected sex in the previous four weeks and whether the respondent had a child out of wedlock.

Several interesting trends arise from these descriptive models. Turning first to the results in table 3, which estimate whether the respondent had unprotected sex in previous four weeks, one main trend stands out. When food insecurity is statistically significant (concentrated mostly in the unconstrained and income-only controlled models (1-4)), the effects appear to be

positively correlated with unprotected sex for males and negatively correlated for females. Specifically, there are statistically significant, positive associations between LFSS and MCFSS and unprotected sex in the unconstrained models for the overall sample and for the male sample. EAFSS is also positively correlated in unconstrained model estimated on the male sample. For the female sample, LFSS is negatively correlated with unprotected sex in models 3 and 5, and EAFSS is negatively correlated with the outcome in model 4. Thus, it appears that to the extent that there is an association between food insecurity and unprotected sex, the association is positive for males and negative for females.

Table 4 presents findings for models estimating the number of sexual partners. We find that LFSS and MCFSS (ages 5-10) are positively correlated and statistically significant in all models estimated on the full sample. The effects attenuate slightly as we add controls, but even in the fully-specified models (models 5 and 6) that control for income and sociodemographics, the coefficients remain substantive and statistically significant. The IRR interpretation is the percent change in the incidence rate of the outcome variable for every one-unit increase in FSS. In this case, as LFSS increases by one unit, the number of sexual partners increases by 2.9 percent, holding all other variables constant. When looking at each of the stage-specific childhood models (models 2, 4, and 6), it appears that the MCFSS fully accounts for the LFSS coefficient. The incidence rates for the MCFSS are nearly as large as the LFSS and neither of the other two childhood FSSs are statistically significant.

The gender-specific subsamples demonstrate that the FSS effects on the number of sexual partners are driven primarily by the male respondents. The IRRs in column five, which show results for the male subsample, mirror those in column three for the full subsample and the effect sizes are substantively larger. The only FSS IRRs that are statistically significant on the female

subsample are those for MCFSS. Thus, it appears that lifetime experiences of food insecurity and food insecurity experienced during the middle childhood period are associated with more sexual partners and that the correlation is much stronger for males than for females.

Table 5 reports the estimated FSS effects on whether the respondent has a child out of wedlock. Looking first at column three, the basic models with no controls demonstrate statistically significant and positive estimated effects of LFSS and the three stage-specific FSSs. However, these results attenuate to zero once we add income and other sociodemographic controls.

In the gender-specific estimations, the male sample tracks the exact patterns found in the full sample for out of wedlock births in that bivariate results attenuate once controls are added to the model. The estimated coefficients for the female sample are likewise similar, with the exceptions of models 3 and 4, which control for income only. Specifically, there are positive associations between LFSS and MCFSS and child out of wedlock that were not indicated in either the full or male samples but these also attenuate to zero once we add in the full set of control variables

Table 6 reports estimated FSS effects on the respondent's number of children. The estimated LFSS coefficients for all models are statistically significant and positive in the full sample. In terms of the childhood stage-specific food insecurity, the estimated effects for EAFSS are positive and statistically significant in all three models. The IRR for model 5 indicates that as LFSS increases by one unit, the number of children increases by 2.8 percent, holding all other variables constant. The childhood stage-specific models show that, once adding controls, the effects for EAFSS are substantively similar to, or larger than, the estimated effect for LFSS. As

EAFSS increases by one unit, the number of children increases by 5.1 percent, controlling for all sociodemographic variables in the fully-specified model.

The gender-specific estimations indicate that, once again, the males may be driving the childhood stage-specific results, as none of the childhood stage-specific coefficients are statistically significant in the female estimations once controls are added to the model. In addition, the substantive effect of the coefficients in the male subsample are even larger than for the full sample. For example, in model 6 for the male subsample, as EAFSS increases by one unit, the number of children increases by 11.7 percent.

Finally, table 7 presents the marginal effects from probit regressions estimating FSS on whether the respondent has ever been arrested. In models estimated on the full sample , the marginal effects for LFSS, MCFSS, and EAFSS are positive and statistically significant. Model 5 indicates that that a one-unit change in LFSS increases the probability of ever being arrested by one percentage point. Model 6 indicates that a one-unit change in MCFSS increases the probability of ever being arrested by 0.7 percentage points. Statistical significance aside, these effect sizes have qualitative significance, on the order of roughly 2.5 percent.

Columns four and five suggest that, similar to the results found in tables 4 (number of sexual partners) and table 6 (number of children) the estimated coefficients for the LFSS in the overall sample are driven by their effects on the male respondents. EAFSS is positive and statistically significant in the female sample for models 4 and 6, however, these coefficients are only marginally significant with p-values between 0.05 and 0.10. There are additional differences in the stage-specific estimations between the female and male samples on the arrest outcome. Specifically, only the EAFSS are positive and statistically significant for females, while only the MCFSS are positive and statistically significant for the males. Thus, once again,

interesting gender differences in the association between exposure to food insecurity during childhood and risky behaviors are apparent.

V. Discussion

This study builds upon the scholarship characterizing the correlates of early childhood food security by focusing on important developmental periods in middle childhood, early adolescence, and middle adolescence. This study examines five outcomes in the broad areas of sexual risk-taking and criminal justice involvement. We began by motivating the direct and indirect pathways through which exposure to food insecurity could affect later outcomes. Then, we describe important changes occurring in the three childhood stages that could account for especially harmful and persistent food security effects. We used data from the Panel Study of Income Dynamics to estimate young adult impacts sexual risk taking and criminal justice involvement of average food security felt in discrete childhood stages – middle childhood (ages five to 10), early adolescence (ages 11 to 14), and middle adolescence (ages 15 to18). Finally, we estimated all six models for each of the five outcomes of interest separately on the overall sample, female young adult sample, and male young adult sample.

We find consistent evidence that the mean food security scale scores in middle childhood and early adolescence are associated with the criminal justice involvement outcome – ever been arrested. The unconstrained models show that LFSS, MCFSS, and EAFSS are all related to ever having been jailed. However, the male respondents appeared to be more sensitive to the effects of the earlier time period, while the female respondents appeared to be more sensitive to the middle time period. These results hold in models 3-6, although the effects attenuate slightly as additional controls are added to the models.

The results are not as consistent with the sexual risk taking outcomes. The results of the unconstrained models (1 and 2) across tables 3-6 suggest that LFSS and MCFSS are positively associated with all four sexual risk-taking outcomes. In addition, the analyses separated by gender indicate that males are particular sensitive to the effects of food insecurity. In terms of the timing of food insecurity, the youngest stage examined here, middle childhood, appears to be statistically related to all four sexual risk-taking outcomes, suggesting the particularly long-lasting effects of food insecurity experienced during this important developmental stage. However, all three time periods have statistically significant associations with the most extreme sexual risk-taking outcomes (out of wedlock birth and number of children.) In the unconstrained models, these results are fairly consistent across gender groups.

When we add covariates (models 3-6), the coefficient sizes and statistical significance often attenuate in expected ways. However, it is noteworthy that the inclusion of controls beyond income do not change the results in meaningful ways. As such, the coefficients found in models 5 and 6 are generally similar to those in models 3 and 4.

Results by life stage indicate that different childhood stages matter for different outcomes. Overall, middle childhood FSS is associated with the number of sexual partners in young adulthood, while early adolescent FSS is associated with the number of children in young adulthood. In addition, males appear to be driving most of the childhood stage-specific findings, especially those for the number of sexual partners and the number of children.

This study highlights the need for scholarship to focus on important developmental periods beyond early childhood. While early childhood is, undoubtedly, the stage in which humans undergo the most biological and social changes, these results show that food security, or the lack thereof, experienced during other important developmental periods is associated with

persistent, negative young adult outcomes. Research should continue to isolate the developmental timing of exposures in affecting outcomes over the life course as this is a critical area of research.

It is unclear why middle childhood FSS is consistently linked to the criminal justice involvement outcomes, but only related to one of the sexual risk taking outcomes (number of sexual partners.) In addition, early adolescent FSS is only related to one sexual risk-taking outcome (number of children). Future scholarship should continue to study and characterize the interplay between stressful life experiences such as food insecurity and human development so that decision makers can design policy interventions in ways that are most effective at negating stressful events' harmful impacts. For example, while there are several food and nutrition programs that focus on the early childhood period (WIC and CACFP), there are none that are crafted for the middle childhood and early adolescent periods. While an argument could be made that school lunch programs fill this void, developmentally-appropriate behaviors such as social comparisons may render these programs less effective because social stigma leads to sub-optimal participation levels. Developmentally appropriate, food-security-targeted interventions for these age groups could have benefits in terms reducing young adult sexual risk taking and criminal justice involvement.

Finally, this study is descriptive in nature and we are unable to say definitively that there is a causal relationship between LFSS, MCFSS, and EAFSS and sexual risking taking and criminal justice outcomes. The PSID allows us to control for a wide range of factors in a longitudinal manner, including permanent income and its variance. However, food insecurity is only sporadically measured and there are many missing points of observation so there is ample reason for caution when interpreting these results. This area of research could benefit from using

a variety of methods and data sources to explore properly the causal relationship between exposure to food insecurity during different points of childhood and later life, similar to the research on the lifetime consequences of poverty (Duncan and Brooks-Gunn 1997).

References

Ackerman, B. P., Brown, E. D., & Izard, C. E. (2004). The relations between persistent poverty and contextual risk and children's behavior in elementary school. *Developmental Psychology*, 40(3), 367–377.

Alaimo, K., Olson, C.M., Frongillo, E.A. Jr. (2001). Food insufficiency and American school-aged children's cognitive, academic, and psychosocial development. *Pediatrics*, 108, 44–53.

Coleman-Jensen, A., Rabbitt, M.P., Gregory, C.A., & Singh, A. (2017). Household Food Security in the United States in 2016, ERR-237, U.S. Department of Agriculture, Economic Research Service.

Coleman-Jensen, A., McFall, W., Nord, M., (2013). Food Insecurity in Households with Children: Prevalence, Severity, and Household Characteristics, 2010–11. Washington, DC.

Coleman-Jensen, A., Rabbitt, M.P., Nord, M., Singh, A., (2015). Household Food Security in the United States in 2014 USDA Economic Research Report No 194. Washington, DC.

Cunha, F., Heckman, J. J., Lochner, L., & Masterov, D. V. (2006). Interpreting the evidence on life cycle skill formation. *Handbook of the Economics of Education*, 1, 697-812.

DiClemente, R. J., Hansen, W. B., & Ponton, L. E. (1996). Adolescents at risk. In Handbook of adolescent health risk behavior (pp. 1-4). Springer, Boston, MA.

Dodge, K. A., & Pettit, G. S. (2003). A biopsychosocial model of the development of chronic conduct problems in adolescence. *Developmental psychology*, *39*(2), 349.

Duncan, G. J., Dowsett, C.J., Claessens, A., Magnuson, K., Huston, A.C., Klebanov, P., Pagani, L.S. et al. (2007). School readiness and later achievement. *Developmental psychology* 43, 6, 1428.

Eccles, J. S. (1999). The development of children ages 6 to 14. *The future of children*, 30-44.

Eccles, J.S., Midgley, C., Wigfield, A., et al. (1993). Development during adolescence: The impact of stage-environment fit on adolescents' experiences in schools and families. *American Psychologist*, 48, 90-101.

Erikson, E. H. (1963). Childhood and society (2nd ed.). New York: Norton.

Evans, G. W., Li, D., & Whipple, S. S. (2013). Cumulative risk and child development. *Psychological Bulletin*, 139,6, 1342.

Georgieff, M.K., (2007). Nutrition and the developing brain: nutrient priorities and measurement. *American Journal of Clinical Nutrition*. 85,2, 614S–620S.

Gundersen, C., Ziliak, J.P., (2015). Food insecurity and health outcomes. *Health Affairs*. 34,11, 1830–1839.

Hamersma, S., & Kim, M. (2015). Food security and teenage labor supply. *Applied Economic Perspectives and Policy*, *38*(1), 73-92.

Howard, L. L. (2011). Does food insecurity at home affect non-cognitive performance at school? A longitudinal analysis of elementary student classroom behavior. *Economics of Education Review*, 30,1, 157-176.

Jyoti, D. F., Frongillo, E. A., & Jones, S. J. (2005). Food insecurity affects school children's academic performance, weight gain, and social skills. *The Journal of nutrition*, *135*,12, 2831-2839.

King, C. (2018). Food insecurity and child behavior problems in fragile families. *Economics and Human Biology.* 28, 14-22.

Kleinman, R.E., Murphy, J.M., Little, M., Pagano, M.E., Wehler, C.A., Regal, K., & Jellinek, M.S. (1998). Hunger in Children in the United States: Potential Behavioral and Emotional Correlates. *Pediatrics* 101,1, E3.

Kraemer, H. C., Lowe, K. K., & Kupfer, D. J. (2005). To your health. NewYork, NY: Oxford University Press.

MacFadyen, A. J., MacFadyen, H. W., & Prince, N. J. (1996). Economic stress and psychological well-being: An economic psychology framework. Journal of Economic Psychology, 17(3), 291–311.

Masten, A. S., Roisman, G. I., Long, J. D., Burt, K. B., Obradović, J., Riley, J. R., ... & Tellegen, A. (2005). Developmental cascades: linking academic achievement and externalizing and internalizing symptoms over 20 years. *Developmental psychology*, *41*(5), 733.

McIntyre, Lynn, Jeanne VA Williams, Dina H. Lavorato, and Scott Patten. 2013. "Depression and suicide ideation in late adolescence and early adulthood are an outcome of child hunger." *Journal of Affective Disorders* 150(1):123-129.

McLaughlin, Katie A., Jennifer Greif Green, Margarita Alegría, E. Jane Costello, Michael J. Gruber, Nancy A. Sampson, and Ronald C. Kessler. 2012. "Food insecurity and mental disorders in a national sample of US adolescents." *Journal of the American Academy of Child & Adolescent Psychiatry* 51(12):1293-1303.

Murphy, J. M., Wehler, C. A., Pagano, M. E., Little, M., Kleinman, R. E. & Jellinek, M. S.

(1998) Relationships between hunger and psychosocial functioning in low-income American children. *Journal of the American Academy of Child Adolescent Psychiatry* 37: 163–171.

Shonkoff, J. P., & Phillips, D. A. (Eds.). (2000). From neurons to neighborhoods: The science of early childhood development. Washington, DC: National Academy Press.

Simmons, R. G. (2017). *Moving into adolescence: The impact of pubertal change and school context*. Routledge.

Slack, K. & Yoo, J. (2005). Food Hardship and Child Behavior Problems among Low-Income Children," *Social Service Review*, 79, 3, 511-536.

Slopen, N., Fitzmaurice, G., Williams, D. R., & Gilman, S. E. (2010). Poverty, food insecurity, and the behavior for childhood internalizing and externalizing disorders. *Journal of the American Academy of Child & Adolescent Psychiatry*, *49*, 5, 444-452.

Steinberg, L. 2009. "Adolescent development and juvenile justice." *Annual Review of Clinical Psychology* 5:459-485.

Weinreb, L., Wehler, C., Perloff, J., Scott, R., Hosmer, D., Sagor, L., et al. (2002). Hunger: Its impact on children's health and mental health. Pediatrics, 110(4), e41.

Whitaker, R., Phillips, S., & Orzol, S. (2006). Food insecurity and the risks of depression and anxiety in mothers and behavior problems in their preschool-aged children. *Pediatrics*, 118, 3, E859-68.

Wigfield, A., Byrnes, J. P., & Eccles, J. S. (2006). Development during early and middle adolescence. *Handbook of educational psychology*, 2, 87-113.

Table 1. Means and standard deviations of food insecurity, outcome variables and control variables for the overall sample and subsample of interest.

	Full Sample		If Ever Any Affirmative Response to 18 Food Security Module Questions ('97, '99, '01, '03)	
	Mean	S.D.	Mean	S.D
Food Insecurity and Income				
Mean Lifetime Food Security (0-18)	**0.89**	**1.44**	**1.39**	**1.60**
Mean FSS Middle Child. (ages 5-10)	**0.83**	**1.47**	**1.20**	**1.72**
Mean FSS Early Adol. (ages 11-14)	**0.97**	**1.36**	**1.34**	**1.55**
Mean FSS Middle Adol. (15-18)	**0.79**	**1.16**	**0.95**	**1.40**
Permanent Income	**$72,342**	**$71,950**	**$63,142**	**$72,161**
Standard Deviation of Income	**$34,740**	**$49,859**	**$32,315**	**$51,269**
Outcomes				
Unprotected sex[a]	**6.39**	**24.47**	**7.39**	**26.16**
Number of sexual partners	**5.74**	**1.73**	**6.20**	**12.63**
Child out of wedlock[a]	**0.18**	**0.38**	**0.21**	**0.41**
Number of children	**0.38**	**0.86**	**0.45**	**0.94**
Ever arrested[a]	**0.20**	**0.40**	**0.22**	**0.42**
Controls				
European American[a]	**0.45**	**0.50**	**0.38**	**0.48**
African American[a]	**0.40**	**0.49**	**0.46**	**0.50**
Latino/a[a]	**0.12**	**0.33**	**0.14**	**0.34**
Other Race [a]	0.02	0.16	0.03	0.16
Maternal Ed. Level	**10.56**	**5.79**	**10.33**	**5.68**
Age	**22.11**	**2.62**	**22.30**	**2.58**
Female [a]	0.53	0.50	0.53	0.50
Neighborhood Quality 1997	**2.34**	**1.11**	**2.48**	**1.14**
Neighborhood Quality 2002	**2.29**	**1.14**	**2.43**	**1.19**
Individual—years	6,190		4,410	

[a] Dichotomous variable

Notes: All numbers unweighted averages. Bolded cells indicate statistically different averages between the two samples.

Table 2. Data Collection Timing

Age in 1997	Data points for mean food security scale in: Middle Childhood (ages 6-10)	Early Adolescence (ages 11-14)	Middle Adolescence (ages 15-18)	# of TA Data Points	In Sample?
0	1	0	0	1	N
1	1	0	0	1	N
2	2	0	0	2	N
3	2	0	0	2	N
4	3	0	0	3	N
5	2	1	0	3	N
6	**3**	**1**	**0**	**4**	**Y**
7	**2**	**2**	**0**	**4**	**Y**
8	**2**	**2**	**0**	**4**	**Y**
9	**1**	**2**	**1**	**4**	**Y**
10	**1**	**2**	**1**	**4**	**Y**

Table 3: Marginal Effects from Probit Models Estimating Food Insecurity Effects on Unprotected Sex.

	Mean FSS Measure	Full Sample	Female Sample	Male Sample
Model 1: No controls	Lifetime FSS (5-18)	0.005**	-0.011	0.010***
Model 2: No controls	Middle Childhood FSS (5-10)	0.004*	0.002	0.005*
	Early Adolescent FSS (11-14)	0.001	-0.006	0.007*
	Mid. Adolescent FSS (15-18)	-0.001	-0.000	-0.007
Model 3: Income controls	Lifetime FSS (5-18)	-0.000	-0.008**	0.006*
Model 4: Income controls	Middle Childhood FSS (5-10)	0.000	-0.002	0.002
	Early Adolescent FSS (11-14)	-0.001	-0.008*	0.005
	Mid. Adolescent FSS (15-18)	-0.003	-0.003	-0.003
Model 5: Full control set	Lifetime FSS (5-18)	0.000	-0.007**	0.007
Model 6: Full control set	Middle Childhood FSS (5-10)	0.000	-0.002	0.002
	Early Adolescent FSS (11-14)	-0.000	-0.007	0.006
	Mid. Adolescent FSS (15-18)	-0.003	-0.002	-0.004
Individual—years		4,661	2,447	2,153

Note: ***p<0.01; **p<0.05; *p<0.10
All models include controls for unknown FSS.
Full set of controls includes: permanent income (ages 0-18), standard deviation of permanent income, race, sex, age, mother's education level, neighborhood conditions, and unknown early and late food insecurity.

Note: The sample size for the Unprotected Sex outcome is smaller because the Transition into Adulthood only collected this measure in 2011, 2013, and 2015.

Table 4: Incidence Rate Ratios from Negative Binomial Models Estimating Food Insecurity Effects on Number of Sexual Partners.

	Mean FSS Measure	Full Sample	Female Sample	Male Sample
Model 1: No controls	Lifetime FSS (5-18)	1.065***	1.011	1.094***
Model 2: No controls	Middle Childhood FSS (5-10)	1.056***	1.032*	1.060***
	Early Adolescent FSS (11-14)	1.016	0.980	1.037
	Mid. Adolescent FSS (15-18)	1.016	1.003	1.039
Model 3: Income controls	Lifetime FSS (5-18)	1.052***	1.015	1.068***
Model 4: Income controls	Middle Childhood FSS (5-10)	1.048***	1.034*	1.046**
	Early Adolescent FSS (11-14)	1.010	0.982	1.026
	Mid. Adolescent FSS (15-18)	1.011	1.004	1.028
Model 5: Full control set	Lifetime FSS (5-18)	1.029**	1.014	1.051***
Model 6: Full control set	Middle Childhood FSS (5-10)	1.029**	1.019	1.044**
	Early Adolescent FSS (11-14)	1.012	1.011	1.004
	Mid. Adolescent FSS (15-18)	1.000	0.980	1.033
Individual—years		6,918	3,669	3,249

Note: ***p<0.01; **p<0.05; *p<0.10

All models include controls for unknown FSS.

Full set of controls includes: permanent income (ages 0-18), standard deviation of permanent income, race, sex, age, mother's education level, neighborhood conditions, and unknown early and late food insecurity.

Table 5: Marginal Effects from Probit Models Estimating Food Insecurity Effects on Child Out of Wedlock.

	Mean FSS Measure	Full Sample	Female Sample	Male Sample
Model 1: No controls	Lifetime FSS (5-18)	0.031***	0.041***	0.023***
Model 2: No controls	Middle Childhood FSS (5-10)	0.018***	0.028***	0.009**
	Early Adolescent FSS (11-14)	0.013***	0.013**	0.014***
	Mid. Adolescent FSS (15-18)	0.013***	0.012**	0.013**
Model 3: Income controls	Lifetime FSS (5-18)	0.004	0.008*	-0.000
Model 4: Income controls	Middle Childhood FSS (5-10)	0.002	0.007*	-0.001
	Early Adolescent FSS (11-14)	0.001	0.001	0.001
	Mid. Adolescent FSS (15-18)	0.002	-0.001	0.004
Model 5: Full control set	Lifetime FSS (5-18)	0.001	0.003	-0.000
Model 6: Full control set	Middle Childhood FSS (5-10)	0.000	0.002	-0.000
	Early Adolescent FSS (11-14)	0.002	0.003	-0.000
	Mid. Adolescent FSS (15-18)	0.002	-0.004	0.002
Individual—years		6,918	3,669	3,249

Note: ***p<0.01; **p<0.05; *p<0.10

All models include controls for unknown FSS.

Full set of controls includes: permanent income (ages 0-18), standard deviation of permanent income, race, sex, age, mother's education level, neighborhood conditions, and unknown early and late food insecurity.

Table 6: Incidence Rate Ratios from Negative Binomial Models Estimating Food Insecurity Effects on Number of Children.

	Mean FSS Measure	Full Sample	Female Sample	Male Sample
Model 1: No controls	Lifetime FSS (5-18)	1.206***	1.202***	1.214***
Model 2: No controls	Middle Childhood FSS (5-10)	1.089***	1.102***	1.074**
	Early Adolescent FSS (11-14)	1.107***	1.055**	1.204***
	Mid. Adolescent FSS (15-18)	1.063***	1.089***	0.996
Model 3: Income controls	Lifetime FSS (5-18)	1.042**	1.042**	1.043
Model 4: Income controls	Middle Childhood FSS (5-10)	1.013	1.017	1.001
	Early Adolescent FSS (11-14)	1.038**	0.999	1.121***
	Mid. Adolescent FSS (15-18)	1.002	1.030	0.934*
Model 5: Full control set	Lifetime FSS (5-18)	1.028*	1.025	1.034
Model 6: Full control set	Middle Childhood FSS (5-10)	0.992	0.996	0.987
	Early Adolescent FSS (11-14)	1.051***	1.007	1.117***
	Mid. Adolescent FSS (15-18)	0.988	1.028	0.931**
Individual—years		6,918	3,669	3,249

Note: ***p<0.01; **p<0.05; *p<0.10

All models include controls for unknown FSS.

Full set of controls includes: permanent income (ages 0-18), standard deviation of permanent income, race, sex, age, mother's education level, neighborhood conditions, and unknown early and late food insecurity.

Table 7: Marginal Effects from Probit Models Estimating Food Insecurity Effects on Ever Arrested

	Mean FSS Measure	Full Sample	Female Sample	Male Sample
Model 1: No controls	Lifetime FSS (5-18)	0.024***	0.014***	0.035***
Model 2: No controls	Middle Childhood FSS (5-10)	0.016***	0.007**	0.024***
	Early Adolescent FSS (11-14)	0.012***	0.009**	0.012*
	Mid. Adolescent FSS (15-18)	0.004	0.000	0.017**
Model 3: Income controls	Lifetime FSS (5-18)	0.014***	0.008**	0.019***
Model 4: Income controls	Middle Childhood FSS (5-10)	0.010***	0.003	0.016***
	Early Adolescent FSS (11-14)	0.007**	0.007*	0.004
	Mid. Adolescent FSS (15-18)	0.001	-0.002	0.012
Model 5: Full control set	Lifetime FSS (5-18)	0.010***	0.005	0.017***
Model 6: Full control set	Middle Childhood FSS (5-10)	0.007**	0.000	0.016***
	Early Adolescent FSS (11-14)	0.006*	0.008*	0.003
	Mid. Adolescent FSS (15-18)	0.000	-0.003	0.008
Individual—years		6,918	3,669	3,249

Note: ***p<0.01; **p<0.05; *p<0.10

All models include controls for unknown FSS.

Full set of controls includes: permanent income (ages 0-18), standard deviation of permanent income, race, sex, age, mother's education level, neighborhood conditions, and unknown early and late food insecurity.